SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F-21-R-40

Name: Diamond Lake **County**: Minnehaha
Legal Description: T104N-R52W-Sec. 5
Location from nearest town: 13 miles north and 2 miles west of Humboldt, SD

Dates of present survey: July 24-26, 2007
Date last surveyed: July 18-19, 2006

Primary Game and Forage Species	Secondary and Other Species
Walleye	Black Bullhead
Yellow Perch	Northern Pike
	White Sucker
	Common Carp
	Green Sunfish
	Orange-spotted Sunfish
	Channel Catfish
	Black Crappie
	Bluegill

PHYSICAL DATA

Surface Area: 256 acres **Watershed area**: No data available
Maximum depth: 12 feet **Mean depth**: 6 feet
Volume: No data available **Shoreline length**: No data
Contour map available: No **Date mapped**: 2002 (shoreline)
Lake elevation observed during the survey: 1 foot low
Beneficial use classifications: (5) warmwater semi-permanent fish propagation, (7) immersion recreation, (8) limited-contact recreation and (9) fish and wildlife propagation and stock watering.

Ownership of Lake and Adjacent Lakeshore Properties

Diamond Lake is listed as meandered public water in the State of South Dakota Listing of Meandered Lakes. Game, Fish, and Parks (GFP) owns the majority of the lake basin as a Game Production Area and manages the fishery. The remainder of the shoreline is privately owned.

Fishing Access

The Diamond Lake Access Area was upgraded in 2005. It consists of a new concrete plank boat ramp, small gravel parking area, a new boat dock and a toilet. Shore fishing access is available in the access area and along the county road grade on the south end of the lake.

Field Observations of Water Quality and Aquatic Vegetation

The water was fairly turbid during the survey with a Secchi depth measurement of 36 cm (14.0 in). Some common cattail (*Typha spp.*) and bulrush (*Scirpus spp.*) exist in shallow bays.

BIOLOGICAL DATA

Methods:

Diamond Lake was sampled on July 24-26, 2007 with three overnight gill net sets and ten overnight trap net sets. The trap nets are constructed with 19-mm-bar-mesh (¾ in) netting, 0.9 m high x 1.5 m wide (3 ft high x 5 ft wide) frames and 18.3 m (60 ft) long leads. The gill nets are 45.7 m long x 1.8 m deep (150 ft long x 6 ft deep) with one 7.6 m (25 ft) panel each of 13, 19, 25, 32, 38 and 51-mm-bar-mesh (½, ¾, 1, 1¼, 1½, and 2 in) monofilament netting. Sampling locations are displayed in Figure 4.

Results and Discussion:

Gill Net Catch

Black bullheads (49.3%) and walleye (27.4%) comprised the majority of the gill-net sample (Table 1). Common carp and yellow perch were also sampled.

Table 1. Total catch from three overnight gill net sets at Diamond Lake, Minnehaha County, July 24-26, 2007.

Species	Number	Percent	CPUE[1]	80% C.I.	Mean CPUE*	PSD	RSD-P	Mean Wr
Black Bullhead	36	49.3	12.0	±1.3	114.0	37	0	87
Walleye	20	27.4	6.7	±3.8	5.9	--	--	82
Common Carp	12	16.4	4.0	±0.7	16.3	17	17	86
Yellow Perch	5	6.8	1.7	±2.1	194.9	--	--	--

* 5 year (1998, 2000, 2002, 2004, 2006)

Trap Net Catch

Black bullheads (93.9%) and common carp (4.3%) dominated the trap net sample (Table 2). Other species caught included walleye, yellow perch, northern pike, white sucker, and black crappie.

[1] See Appendix A for definitions of CPUE, PSD, and mean Wr.

Table 2. Total catch from ten overnight trap net sets at Diamond Lake, Minnehaha County, July 24-26, 2007.

Species	Number	Percent	CPUE	80% C.I.	Mean CPUE*	PSD	RSD-P	Mean Wr
Black Bullhead	2,566	93.9	256.6	±100.0	1,001.0	28	1	85
Common Carp	117	4.3	11.7	±7.0	9.1	18	11	88
Walleye	40	1.5	4.0	±1.8	1.2	63	4	75
Yellow Perch	6	0.2	0.6	±0.3	12.8	--	--	--
Northern Pike	2	0.1	0.2	±0.2	1.0	--	--	--
White Sucker	1	0.0	0.1	±0.1	0.3	--	--	--
Black Crappie	1	0.0	0.1	±0.1	0.0	--	--	--

* 5 years (1998, 2000, 2002, 2004, 2006)

Walleye

Management objective: Establish and maintain a high density, high quality walleye population to control the overabundant black bullhead population in Diamond Lake.

On January 1, 2003, the daily limit for walleyes in Diamond Lake was reduced to one fish that must be at least 61 cm (24 in) long. The primary objective of this experimental regulation was to create a high-density population of large walleyes capable of controlling the chronic overabundant black bullhead population in the lake (Table 6). Several years of stocking were needed to establish and maintain the population (Table 10).

Despite almost annual walleye stocking since 1998, walleye gill net CPUE has remained below expectations (Table 3). However, because walleye catch rates increased nearly a hundredfold this year (Table 8), we suspect our gill nets may not be effectively sampling the population.

Incremental growth of 4-7 year old walleyes in 2007 was relatively slow (Table 4). Curiously, yearling walleyes exhibited rapid growth (Table 4) but below average condition (mean Wr = 84). Walleye condition overall has declined since 2002 (Table 3).

Table 3. Walleye gill-net CPUE, PSD, RSD-P, and mean Wr for Diamond Lake, Minnehaha County, 1998-2007.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Mean*
CPUE	0.0		11.5		5.7		2.3		10.0	6.7	5.9
PSD	--		88		93		100		49	--	83
RSD-P	--		0		21		17		11	--	12
Mean Wr	--		97		102		92		85	82	94

*5 years (1998, 2000, 2002, 2004, 2006)

Table 4. Average back-calculated lengths (mm) for each age class of walleye in Diamond Lake, Minnehaha County, 2007.

			Back-calculation Age							
Year Class	Age	N	1	2	3	4	5	6	7	8
2006	1	15	173							
2005	2	3	137	238						
2002	5	1	168	270	354	398	434			
2001	6	1	165	273	408	429	457	472		
All Classes		**20**	**167**	**251**	**381**	**413**	**446**	**472**		
Statewide Mean			168	279	360	425	490			
Region III Mean			173	281	367	435	517			
LLI* Mean			169	280	358	425	494			

Yellow Perch

Management objective: Maintain a yellow perch population with a gill-net CPUE of at least 50 and a PSD range of 30-60.

Yellow perch gill net CPUE decreased from 15.0 in 2006 to only 1.7 in 2007 (Table 5). The mean length of the yellow perch sampled was 217 mm (8.5 in) long (Figure 2). The decline of the perch population is likely related to the same conditions responsible for a general, region-wide lack of perch reproduction since 2002 but an increase in walleye abundance and size structure could be having an effect as well.

Table 5. Yellow perch gill-net CPUE, PSD, RSD-P, and mean Wr for Diamond Lake, Minnehaha County, 1998-2007.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Mean*
CPUE	812.0		65.0		73.3		9.3		15.0	1.7	194.9
PSD	60		2		8		93		87	--	50
RSD-P	13		0		0		0		16	--	6
Mean Wr	90		87		107		97		81	--	92

*5 years (1998, 2000, 2002, 2004, 2006)

Black Bullhead

Management objective: Maintain a black bullhead population with a trap-net net CPUE of less than 100.

The black bullhead trap net CPUE was 256.6 after being near the objective of 100 in 2004 (Table 6). Still, bullhead abundance remains low relative to that seen in 1998-2002. A PSD of 28, an RSD-P of 1 and Figure 3 describe a population of small fish with a mean length of 222 mm (8.7 in).

Table 6. Black bullhead trap-net CPUE, PSD, RSD-P, and mean Wr for Diamond Lake, Minnehaha County, 1998-2007.

	1998	2000	2002	2003	2004	2006	2007	Mean*
CPUE	1381.4	2000.0	1,229.4		104.7	289.4	256.6	1001.0
PSD	2	0	63		69	9	28	29
RSD-P	0	0	0		7	0	1	1
Mean Wr	--	--	105		86	85	85	92

*5 years (1998, 2000, 2002, 2004, 2006)

All Species

Yellow perch and white sucker CPUE was the lowest ever recorded while the abundance of other species remains relatively unchanged (Table 7).

Table 7. Gill-net (GN) and trap-net (TN) CPUE for all fish species sampled in Diamond Lake, Minnehaha County, 1998-2007.

Species	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
COC (GN)	5.0		0.5		21.7		4.3		50.0	4.0
COC (TN)	7.0		1.0		8.0		9.5		19.8	11.7
WHS (GN)	--		0.5		--		--		--	--
WHS (TN)	0.4		0.2		0.3		0.3		0.5	0.1
BLB (GN)	115.5		206.5		106.7		108.0		33.3	12.0
BLB (TN)	1,381.4		2000.0		1,229.4		104.7		289.4	256.6
CCF (GN)	--		--		--		--		--	--
CCF (TN)	--		--		--		0.1		--	--
NOP (GN)	5.5		4.0		1.3		0.3		--	--
NOP (TN)	4.0		0.4		--		0.5		0.3	0.2
GSF (GN)	--		--		--		--		--	--
GSF (TN)	0.4		--		--		0.7		0.7	--
OSF (GN)	--		--		--		--		--	--
OSF (TN)	--		--		--		0.2		--	--
HYB (GN)	--		--		--		--		--	--
HYB (TN)	--		--		--		0.1		--	--
BLG (GN)	--		--		--		--		--	--
BLG (TN)	--		--		--		0.1		0.1	--
BLC (GN)	--		--		--		--		--	--
BLC (TN)	--		--		--		0.1		0.1	0.1
YEP (GN)	812.0		65.0		73.3		9.3		14.7	1.7
YEP (TN)	44.2		1.4		16.0		0.7		1.9	0.6
WAE (GN)	--		11.5		5.7		2.3		10.0	6.7
WAE (TN)	--		--		--		0.8		5.3	4.0

COC (Common Carp), WHS (White Sucker), BLB (Black Bullhead), CCF (Channel Catfish), NOP (Northern Pike), GSF (Green Sunfish), OSF (Orangespotted Sunfish), HYB (Hybrid Sunfish), BLG (Bluegill), BLC (Black Crappie), YEP (Yellow Perch), WAE (Walleye),

Creel Survey Results

A creel survey was conducted from May through August 2004-2007 to obtain baseline information on Diamond Lake and to monitor the effect of the special walleye regulation. All angling parties interviewed were residents of South Dakota and they fished an estimated 3,855 hours or about 15 h/acre (Table 8) this summer. The average length of a fishing trip over the four year period was about 2.5 h.

Anglers enjoyed good fishing for walleyes and black bullheads from June through August, 2007. Walleye catch was highest this yea, but no fish have been harvested since 2004. Northern pike and yellow perch catch was highest in 2004 while black bullhead catch was highest in 2007 and lowest in 2006 (Tables 8 and 9)

Yellow perch and black bullhead catch and harvest rates were relatively low throughout the duration of the survey but a high percentage of fish caught were harvested when they were large enough.

Table 8. Monthly estimates of fishing pressure and catch (harvest) of fish in Diamond Lake from May through August 2004-2006.

	Fishing Pressure (Hours)	Walleye Catch (Harvest)	Northern Pike Catch (Harvest)	Yellow Perch Catch (Harvest)	Black Bullhead Catch (Harvest)
2004	4,077	2,177 (109)	239 (18)	927 (161)	2,124 (944)
2005	4,354	821 (0)	88 (0)	160 (81)	1,411 (0)
2006	2,454	96 (0)	0 (0)	311 (218)	1,040 (265)
2007	4,536	8,897 (0)	0 (0)	206 (162)	2,760 (251)

Table 9. Monthly number of angler interviews and estimates of hourly catch rate (harvest rate) of fish in Diamond Lake from May through August 2004-2006.

	Number of Interviews	Walleye Catch (Harvest)	Northern Pike Catch (Harvest)	Yellow Perch Catch (Harvest)	Black Bullhead Catch (Harvest)
2004	86	0.53 (0.03)	0.06 (0.004)	0.23 (0.04)	0.52 (0.23)
2005	95	0.19 (0)	0.02 (0)	0.04 (0.02)	0.32 (0)
2006	56	0.039 (0)	0 (0)	0.127 (0.089)	0.42 (0.11)
2007	96	1.96 (0)	0 (0)	0.045 (0.036)	0.61 (0.06)

MANAGEMENT RECOMMENDATIONS

1. Finish the evaluation of the one fish over 24 inch daily bag limit, discuss the results with regional and fisheries staff and make a recommendation to keep, modify or discard the regulation by August, 2008.

2. Maintain the walleye population by stocking advanced-sized fish as needed.

3. Aggressively stock yellow perch to reach management objectives and to provide a consistent forage base for the walleye population.

Table 10. Stocking record for Diamond Lake, Minnehaha County, 1990-2007.

Year	Number	Species	Size
1990	110	Northern Pike	Adult
1992	12,690	Northern Pike	Fingerling
	25,250	Yellow Perch	Fingerling
1993	37,000	Yellow Perch	Fingerling
1995	3,050	Yellow Perch	Adult
1997	2,640	Yellow Perch	Adult
	19,485	Yellow Perch	Fingerling
1998	27,700	Walleye	Fingerling
1999	25,600	Walleye	Fingerling
2000	27,000	Walleye	Fingerling
2001	25,600	Walleye	Fingerling
2002	263	Walleye	Adult
2003	149	Walleye	Adult
	51,200	Walleye	Fingerling
2005	24	Walleye	Adult
	8,320	Walleye	Fingerling
2006	25,680	Walleye	Fingerling
	1,771	Yellow Perch	Adult
	1,107	Yellow Perch	Juvenile
	6,645	Walleye	Large Fingerling
2007	2,232	Walleye	Large Fingerling
	476	Yellow Perch	Adult

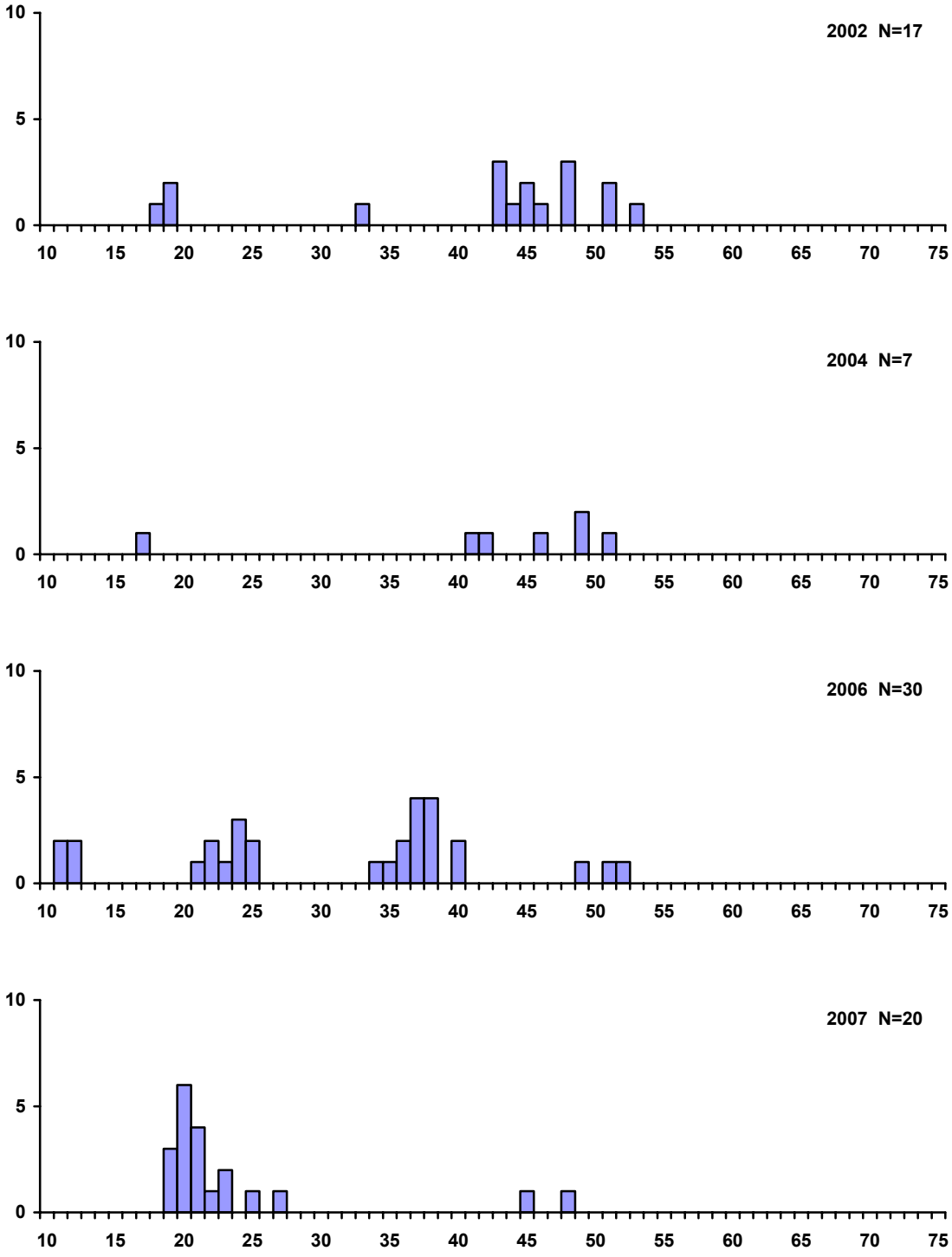

Figure 1. Length frequency histogram for walleye sampled with gill nets in Diamond Lake, Minnehaha County, 2002, 2004, 2006, and 2007.

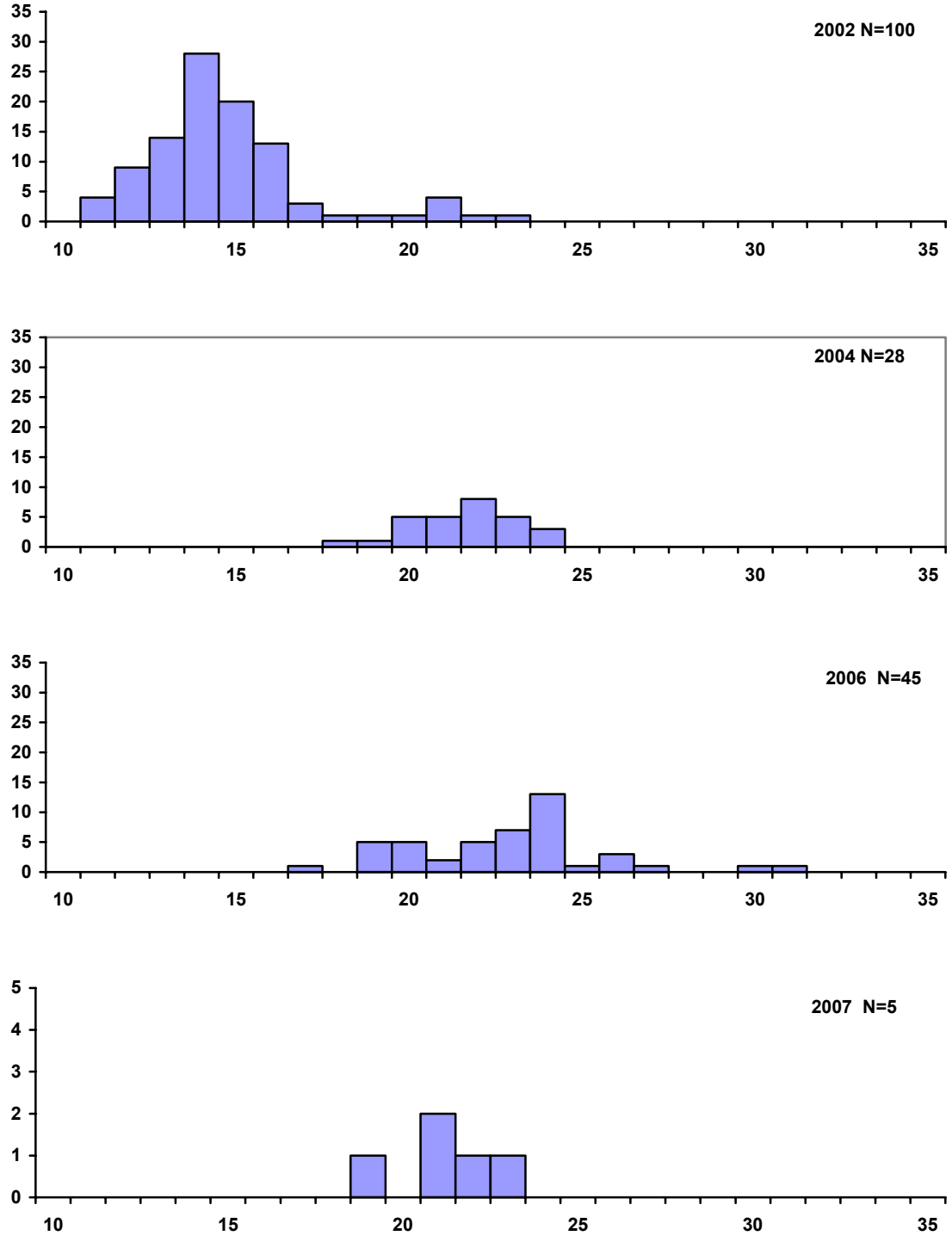

Figure 2. Length frequency histograms for yellow perch sampled with gill nets in Diamond Lake, Minnehaha County, 2002, 2004, 2006, and 2007.

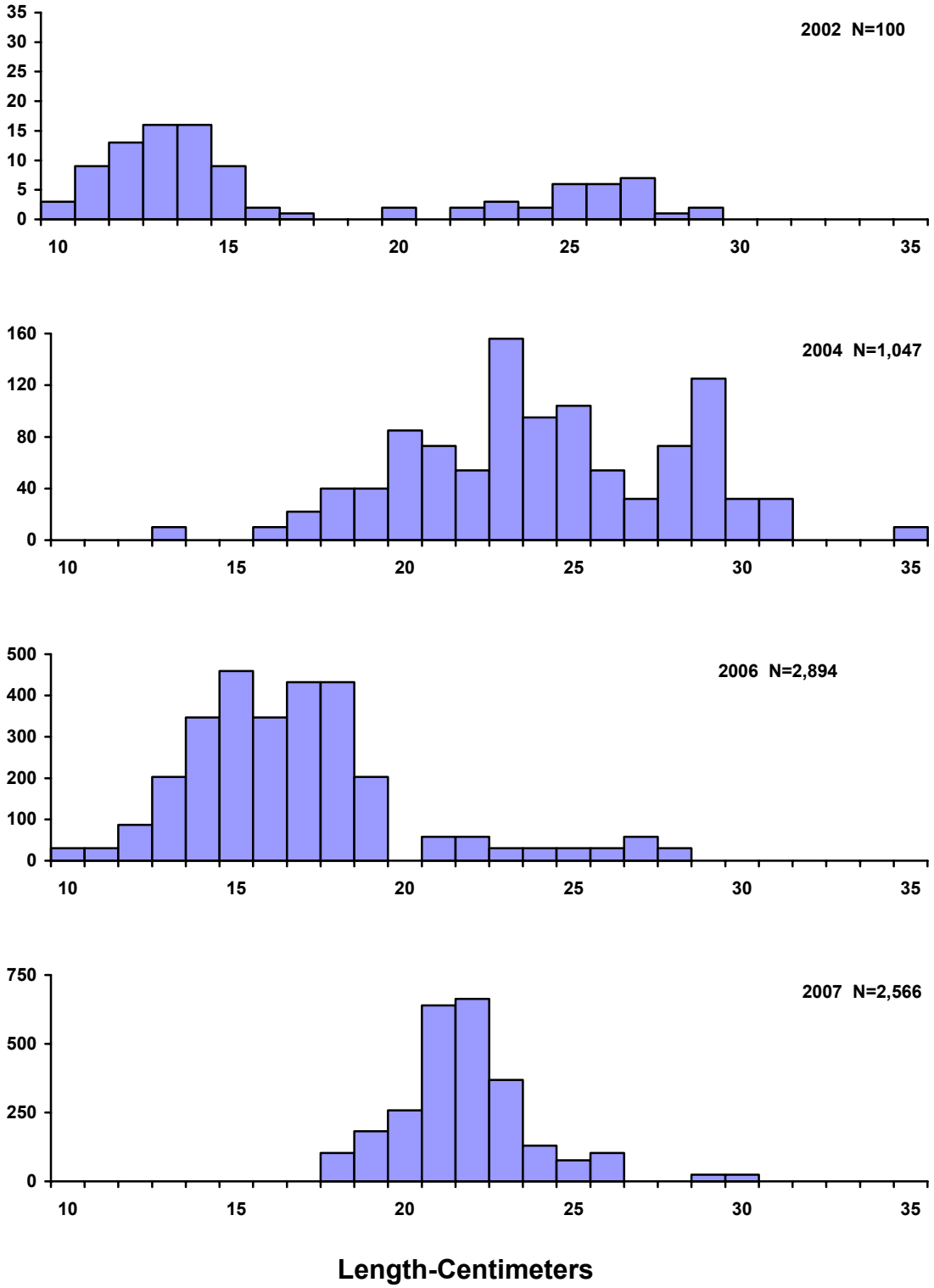

Figure 3. Length frequency histograms for black bullheads sampled with trap nets in Diamond Lake, Minnehaha County, 2002, 2004, 2006, and 2007.

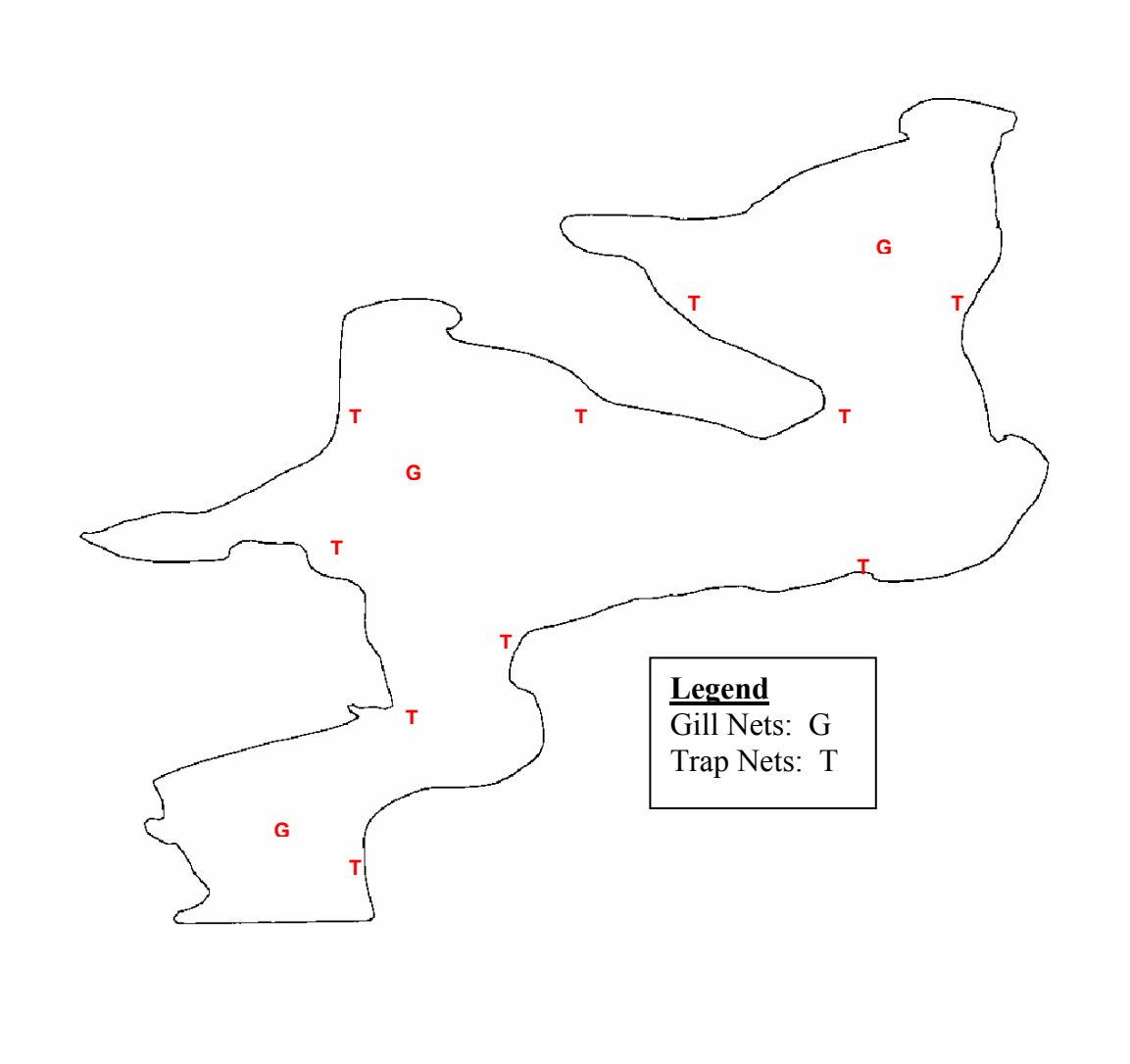

Figure 4. Sampling locations on Diamond Lake, Minnehaha County, 2007.

Appendix A. A brief explanation of catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr).

Catch Per Unit Effort (CPUE) is the catch of animals in numbers or in weight taken by a defined period of effort. Can refer to trap-net nights of effort, gill-net nights of effort, catch per hour of electrofishing, etc.

Proportional Stock Density (PSD) is calculated by the following formula:

$$PSD = \frac{\text{Number of fish} > \text{quality length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

Relative Stock Density (RSD-P) is calculated by the following formula:

$$RSD\text{-}P = \frac{\text{Number of fish} > \text{preferred length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

PSD and RSD-P are unitless and usually calculated to the nearest whole digit.

Size categories for selected species found in Region 3 lake surveys, in centimeters.

Species	Stock	Quality	Preferred	Memorable	Trophy
Walleye	25	38	51	63	76
Sauger	20	30	38	51	63
Yellow perch	13	20	25	30	38
Black crappie	13	20	25	30	38
White crappie	13	20	25	30	38
Bluegill	8	15	20	25	30
Largemouth bass	20	30	38	51	63
Smallmouth bass	18	28	35	43	51
Northern pike	35	53	71	86	112
Channel catfish	28	41	61	71	91
Black bullhead	15	23	30	38	46
Common carp	28	41	53	66	84
Bigmouth buffalo	28	41	53	66	84
Smallmouth buffalo	28	41	53	66	84

For most fish, 30-60 or 40-70 are typical objective ranges for “balanced” populations. Values less than the objective range indicate a population dominated by small fish while values greater than the objective range indicate a population comprised mainly of large fish.

Relative weight (Wr) is a condition index that quantifies fish condition (i.e., how much does a fish weigh for its length). A Wr range of 90-100 is a typical objective for most fish species. When mean Wr values are well below 100 for a size group, problems may exist in food and feeding relationships. When mean Wr values are well above 100 for a size group, fish may not be making the best use of available prey.